NASA Activities

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President Approves Updated Space Policy
LDEF Experiment to Bear Fruit
Drug Free Workplace

NASA operated B-52 carries Pegasus air-launch space booster.

THIS ISSUE

This issue of *NASA Activities* contains excerpts from the "National Space Policy" recently approved by President Bush. It provides policy and guidance that is truly "Back to the Future" oriented, updating and reaffirming U.S. goals in space.

Looking toward future scientists and engineers, over 12.5 million spacefaring tomato seeds carried by the Long Duration Exposure Facility are destined to be distributed to science classes throughout the country. Up to four million students may eventually participate in the great tomato seed experiment. Read about it in "Agency Highlights".

Some recent NASA accomplishments in aeronautics are covered in "Center Highlights" for this issue. They range from hydrogen fuel technology to Visitor Center efforts to inform the public about how their tax dollar is spent.

A tip of the editor's hat for those Purdue University alumni who graciously chose to ignore an accidental editorial modification of their alma mater's name in a recent issue.

NOTICE: NASA Activities will be published on a bi-monthly basis commencing with this issue. Contributors are urged to submit material well in advance of anticipated activities.

Next Month:
The Hubble Space Telescope

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About the Cover

NASA B-52 #008 lifts off runway 22 at Edwards AFB, Calif., in a recent captive (non-launch)flight test conducted from Ames-Dryden Flight Research Facility. The B-52 has been used by NASA for the test of a wide variety of aircraft including X-15s, lifting bodies, the HiMAT highly maneuverable aircraft technology subscale research plane and Space Shuttle solid rocket motor parachute systems.

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Back to the Future – President Approves Updated National Space Policy

Policy Revalidates Ongoing Space Efforts

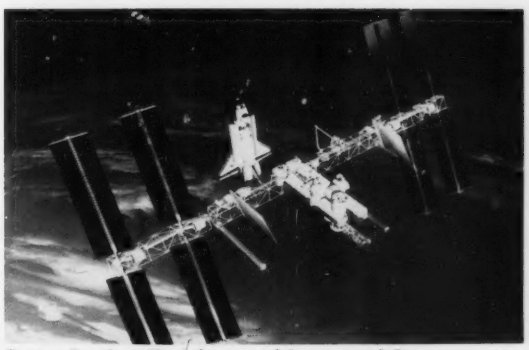
(The following is excerpted from "The White House Fact Sheet: U.S. National Space Policy", November 16, 1989, and the attached document "National Space Policy".)

In early November President Bush approved a national space policy that updates and reaffirms U.S. goals and activities in space. The updated policy is the result of a review undertaken by the National Space Council. The revisions clarify, strengthen, and streamline selected aspects of the policy. Areas affected include civil and commercial remote sensing, space transportation, space debris, federal subsidies of commercial space activities, and Space Station Freedom.

Overall, the President's newly-issued national space policy revalidates the ongoing direction of U.S. space efforts and provides a broad policy framework to guide future U.S. space activities.

The policy reaffirms the nation's commitment to the exploration and use of space in support of our national well being. United States leadership in space continues to be a fundamental objective guiding U.S. space activities. The policy recognizes that leadership requires Unites States preeminence in key areas of space activity critical to achieving our national security, scientific, technical, economic and foreign policy goals. The policy also retains the long-term goal of expanding human presence and activity beyond Earth orbit into the Solar System. This goal provides the overall policy framework for the President's human space exploration initiative, announced July 20, 1989, in which the President called for completing Space Station Freedom, returning permanently to the moon, and exploration of the planet Mars.

The following are excerpts from the unclassified document entitled "National Space Policy."



Space Station Freedom and improved Space Transportation System to ensure U.S. preeminence in critical aspects of manned spaceflight.

GOALS OF THE NATIONAL SPACE POLICY

A fundamental objective guiding U.S. space efforts has been, and continues to be, space leadership. Leadership in an increasingly competitive international environment, does not require U.S. preeminence in all areas and disciplines of our space enterprise. It does require U.S. preeminence in the key areas of space activity critical to achieving our national security, scientific, technical, economic, and foreign policy goals.

The overall goals of U.S. space activities are:

- To strengthen the security of the United States;
- To obtain scientific, technological and economic benefits for the general population and to improve the quality of life on Earth through space related activities;
- To encourage continuing U.S. private-sector investment in space and related activities;
- To promote international cooperative activities, taking into account U.S. national security, foreign policy, scientific and economic interests;
- To cooperate with other nations in maintaining the freedom of space for all activities that enhance the security and welfare of mankind; and as a long range goal,
- To expand human presence and activity beyond Earth orbit into the solar system.

Civil Space Policy

The U.S. civil space sector activities shall contribute significantly to enhancing the Nation's science, technology , economy, pride, sense of well-being and direction, as well as U.S. world prestige and leadership. Civil sector activities shall comprise a balanced strategy of research, development, operations, and technology for science, exploration and appropriate applications.

Objectives of the U.S. civil space activities shall be:

- To expand knowledge of the Earth, its environment, the solar system, and the universe;

continued on next page

•To create new opportunities for use of the space environment through the conduct of appropriate research and experimentation in advance technology and systems;

•To develop space technology for civil applications and, wherever appropriate, make such technology available to the commercial sector;

•To preserve the U.S. preeminence in critical aspects of space science, applications, technology, and manned space flight;

•To establish a permanently manned presence in space; and

•To engage in international cooperative efforts that further U.S. overall space goals.

POLICY GUIDELINES AND IMPLEMENTING ACTIONS

Established by executive order, the National Space Council, chaired by the Vice President, provides a coordinated process for developing the national space policy and strategy and monitors its implementation.

CIVIL SPACE SECTOR GUIDELINES

The Civil Space Sector Guidelines are of primary interest to NASA and provide that NASA will continue the lead role within government for advancing space science, exploration and appropriate applications through research, technology, development and related operations.

Manned Exploration

The document calls for a balanced program of manned and unmanned exploration, expanding human presence and activity beyond Earth orbit into the solar system and developing the necessary technologies for a range of such activities. This technology program (Pathfinder) will be oriented toward a Presidential decision on a focused program of manned exploration of the solar system.

Unmanned Exploration

NASA will continue to pursue a program of unmanned exploration where such exploration can most efficiently and effectively satisfy national space objectives where human presence is undesirable or unnecessary; exploring realms where the risks or cost of life support are unacceptable; and providing data vital to support future manned missions.

Vice President Quayle chairs National Space Council.

Permanent Manned Presence

NASA will develop the Space Station to achieve permanently manned operational capability by the mid-1990s, contributing to the U.S.'s preeminence in critical aspects of manned spaceflight, providing early benefits in materials and life sciences providing and promoting opportunities for commercial sector participation and experimentation and contributing to the longer term goal of expanding human presence and activity beyond Earth orbit.

Manned Spaceflight Preeminence

Approved programs such as efforts to improve and safely operate the Space Transportation System and to develop, deploy and use the Space Station, are intended to ensure U.S. preeminence in critical aspects of manned spaceflight.

Space Applications

NASA and other agencies will pursue the identification and development of appropriate applications flowing from their activities, seeking to promote private sector development and implementation of applications. Applications will create new capabilities or improve quality or efficiency of continuing activities including long-term scientific observations. NASA will seek to ensure its capability to conduct selected critical missions through an appropriate mix of assured access to space, on-orbit sparing, advanced automation techniques, redundancy and other suitable measures.

Civil Government Space Transportation

The unique Space Transportation System capability to provide manned access to space will be exploited in those areas that offer the greatest national return, including contributing to U.S. preeminence in critical aspects of spaceflight. The STS fleet will maintain the Nation's capability and will be used to support critical programs requiring manned presence and other unique STS capabilities. In supporting national space transportation goals, NASA will establish sustainable flight rates to provide for planning and budgeting of Government space programs. NASA will pursue appropriate enhancements to STS operational capabilities, upper stages, and systems for deploying, servicing, and retrieving spacecraft as national an user requirements are defined. ■

(Employees wishing to read the complete text of the unclassified document entitled "National Space Policy" including those aspects dealing with space policy principles, commercial space , national security and intersector policy, policy guidelines and implementation, may do so at the NASA Headquarters Newsroom, Room F6043, Federal Office Building 6, Washington, D.C.)

AGENCY HIGHLIGHTS

LDEF Experiment to Bear Fruit

Space Exposed Tomato Seeds Face Budding Student Scientists

With the retrieval of the 11-ton Long Duration Exposure Facility satellite (LDEF), NASA is offering 12.5 million tomato seeds to budding student scientists/gardeners in the first experiment ever to study the effects of long-term space exposure on living tissue.

It has been more than 5-1/2 years since the Space Shuttle deployed the 12.5 million tomato seeds, housed in the LDEF, into Earth orbit.

LDEF carried 57 experiments concerned with the exposure of materials to the space environment, one of which was SEEDS.

SEEDS (Space Exposed Experiment Developed for Students) is a cooperative educational partnership among NASA Headquarters Educational Affairs Division, Washington, D.C., NASA's Langley Research Center, Hampton, Va., and the George W. Park Seed Co., Greenwood, S.C.

The project was designed as a classroom experiment for U.S. students in grades 5 through university to conduct open-ended research.

NASA Administrator Richard H. Truly said, "Because this is the first opportunity for long-duration space exposure of living tissues, every classroom experiment will be significant. I hope millions of students will experience this hands-on, one-of-a-kind experiment and learn that science is fun."

The SEEDS project has the potential to directly involve 4 million students and 40,000 educators, in 250,000 classrooms.

After LDEF retrieval, the flight seeds are returned to Park Seed Co. where an equal number of control seeds from the same lot have been maintained in a ground-based facility.

Following preliminary growth tests conducted by plant scientists, these seeds will be distributed in late February. Each seed kit will contain 50 flight seeds and 50 control seeds, instructional materials and computerized data collection and reporting booklets.

Students will conduct classroom experiments, including experiment design, data gathering, sample comparison and final reporting results. Upper elementary and secondary levels could compare germination rates and times, seed embryos, phototropic responses and fruit products. Students also could consider the impact of varying environmental factors. Upper secondary and university students could perform chromosome experiments and population genetics studies.

The tomato seed was chosen because students in all geographic areas are familiar with the plant; it is relatively simple to germinate and grow; it is small enough to

continued on page 8

NASA Announces Implementation of Drug Free Workplace Program

NASA has announced that, in support of President Bush's "National Drug Control Strategy", the agency will implement its Drug-Free Workplace Program, effective Jan. 5, 1990.

The program places a strong emphasis on education, training and assistance through the NASA Employee Assistance Program. A limited number of employees will be subject to random drug testing as a means of ensuring a continuing drug-free workplace environment.

Under NASA's program, each employee who is an illegal drug user, has the opportunity to voluntarily identify himself/herself and to receive counseling and rehabilitation. An employee will not be disciplined for illegal drug use if the employee voluntarily requests help before he/she is found to be using illegal drugs by other means such as random testing; successfully completes counseling or rehabilitation; and thereafter refrains from use of illegal drugs. Those employees subject to random testing occupy "sensitive" positions as defined in the NASA program and determined by agency management.

Included among NASA's sensitive positions are: senior-level management officials, including the administrator and his deputy; all center directors; flight related personnel such as astronauts, pilots, mission and payload specialists, flight controllers, test directors and other scientific, engineering and support personnel involved in the execution of manned and unmanned flight-related activities.

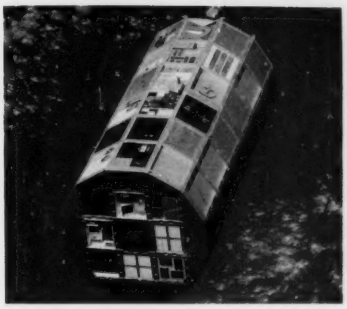
The program also includes, under certain situations, drug testing if there is reasonable suspicion of illegal drug use or an accident or unsafe practice. All drug testing will be conducted in accordance with the mandatory guidelines for Federal workplace drug testing programs issued by the Department of Health and Human Services. ■

STS-33: Night Launch!

The STS-33 Space Shuttle Discovery takes to the nighttime Florida sky November 22, 1989. The classified DOD mission was crewed by (from left to right) Mission Specialist Sonny Carter; Pilot John Blaha; Mission Specialist Kathryn Thornton; Commander Frederick Gregory and Mission Specialist Story Musgrave. STS-33 concluded with a near sunset landing at Edwards AFB, November 27th.

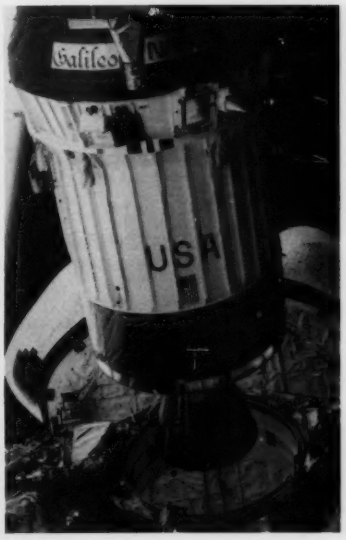
STS-34 "Galileo"

STS-34 crew members pause from their on-orbit duties aboard the Space Shuttle Atlantis for a portrait. The Atlantis crew deployed Galileo (far right), a space probe which will reach Jupiter in December 1995. The crew (from left to right) are: Commander Donald E. Williams, Mission Specialists Ellen S. Baker, Franklin R. Chang-Diaz, Shannon Lucid; and Pilot Michael J. McCulley.



STS-32 Doubleheader — SYNCOM IV Deploy/LDEF Retrieval

A veritable space bus service, the STS-32 mission was to launch the SYNCOM IV (top left, shown during inspection in Florida) communications satellite and to bring back to Earth the Long Duration Exposure Facility (left). Crew for the mission were (first row) Commander Daniel Brandenstein, Pilot James D. Wetherbee, (second row)and Mission Specialists Marsha S. Ivins, David Low and Bonnie J. Dunbar. Young students across the land awaited return of 12.5 million tomato seeds for classroom experiments. See page 5 for more concerning the LDEF tomato seed science program.



CENTER HIGHLIGHTS

Lewis Coordinates Aero-Space Plane Hydrogen Fuel Technology Effort

By Linda S. Ellis, LeRC

When the proposed National Aero-Space Plane (NASP) leaves the runway sometime in the 1990's, the fuel that powers it may be largely the result of technology efforts being coordinated today by NASA Lewis Research Center, Cleveland.

NASP is a joint NASA/Department of Defense program with the ultimate goal of developing an air-breathing experimental flight vehicle designated the X-30. The X-30 will take off horizontally, fly directly into orbit, then land like a conventional aircraft. It also may have the capability to cruise through the atmosphere at sustained hypersonic (above Mach 5) speeds.

Researchers are focusing on "slush" hydrogen, a high-energy hydrogen slurry, as the primary propellant for NASP. It is denser than liquid hydrogen and requires smaller tanks for the same amount of propulsive capability. The tanks themselves can be lighter in weight because slush hydrogen requires an internal pressurization of only 1 pound per square inch. Also, slush hydrogen is a better coolant for the vehicle and engines than liquid hydrogen. Using slush instead of liquid hydrogen "reduces the size of the NASP and reduces the projected gross liftoff weight by up to 30 percent," according to Ned Hannum, Deputy Chief of the Space Propulsion Technology Division, Lewis Research Center.

The slush hydrogen technology development team, headed by Lewis Research Center, was formed about three years ago when very little was known about the material's properties. Each team member is assigned a specific area of research.

National Aero-Space Plane concept by Stan H. Stokes, from the NASA Art Collection.

- The National Institute of Standards and Technology (NIST) is investigating instrumentation, the physical properties of slush hydrogen and production methods. NIST also has a historical data base and experience in slush hydrogen production and pumping.
- McDonnell Douglas and its subcontractors, Air Products, Martin Marietta and Wyle Laboratories, are performing large-scale experimental work in slush production, pressurization, transfer and flow modeling.
- The University of Michigan is working on the gelation of hydrogen and slush hydrogen. Gelated hydrogen probably will not be available for NASP, but may help control sloshing of hydrogen fuels in the propellant tanks of future flight vehicles.
- The University of Colorado is studying slush hydrogen thermal acoustic oscillation phenomena.
- The Los Alamos National Laboratory is investigating the safety aspects of slush hydrogen, including the levels of oxygen contamination that will be acceptable in slush hydrogen propellants.

As part of the in-house activity at Lewis, Air Products has constructed the slush maker at Lewis' Plum Brook Station near Sandusky, Ohio. The plant, slated to begin operation late this winter, will be capable of producing slush hydrogen in 800-gallon batches. The slush facility will allow researchers to explore production, transfer and storage of slush. Lewis' experimental efforts are a major portion of the overall slush hydrogen program. ■

LDEF Experiment, continued...

permit a large number to be flown; and it is proven to be very hardy. Rutgers tomato seeds are open-pollinated, nonhybrids and produce plants with comparatively little variation from generation to generation. Consequently, any changes in the space tomatoes' characteristics will be easy to detect. The Rutgers tomato seed was selected because it has wide adaptation and can be grown in every state.

The SEEDS project gives students the unprecedented opportunity to be involved in a national, first-of-a-kind experiment that encourages both active involvement and an interdisciplinary approach to designing their own investigations to involve decision-making, data-gathering and reporting of final results. ■

Pegasus Air-Launched Space Booster Tested in Captive Flight

NASA Ames-Dryden operated B-52 carrier aircraft hefts 20-ton air-launched space booster Pegasus during a captive flight test.

The Pegasus air-launched space booster has successfully flown its preliminary captive carry flight test from Ames-Dryden Flight Research Facility, Edwards AFB, California, according to the Defense Advanced Research Projects Agency (DARPA). At press time, one of two scheduled flights had taken place and launch of the airborne space booster had been slated for no earlier than this month.

The flights followed a series of low and high-speed taxi tests.

The captive flight tests, during which the Pegasus launch vehicle remains attached to the B-52 carrier aircraft's pylon mount, are conducted to verify the correct functioning of all Pegasus guidance, control, navigation and telemetry systems on board both the Pegasus vehicle and the B-52, which is based at NASA's Ames-Dryden Flight Research Facility.

The Pegasus flown during the captive tests was identical to the vehicle to be launched, except that it has inert rocket motors that cannot be ignited and it remains attached to the B-52.

DARPA and Goddard Space Flight Center provided full-scale engineering test payloads that simulate the payloads to be flown on the first actual launch. Dryden personnel attached instrumentation and sensors to these payload models to provide real flight data on the environmental forces acting on the payloads during taxi, runway takeoff and the time in-flight while attached to the B-52's wing.

The second captive carry test simulates the actual mission flight profile, with the B-52 with Pegasus attached flying to the actual launch point over the Western Test Range, approximately 50 miles off the coast of California.

Flight crew for the tests included NASA test pilots C. Gordon Fullerton and Edward T. Schneider, with Michael D. Bondy serving as in-flight crew chief. Dr. Antonio Elias, of Orbital Science Corporation served as launch officer.

The Pegasus air-launched vehicle is part of DARPA's Advanced Space Technology Program, which will demonstrate high-payoff, advanced technology to improve space systems' operational support to military commanders. The government launch and demonstration of the Pegasus vehicle will be used to evaluate its launch flexibility and utility for support of military objectives. The Pegasus vehicle was developed in a privately funded joint venture between Orbital Science Corporation and Hercules, Inc. ■

An inert Pegasus is suspended from carrier aircraft's test pylon.

Research Flight Results May Aid Future Aircraft Designs

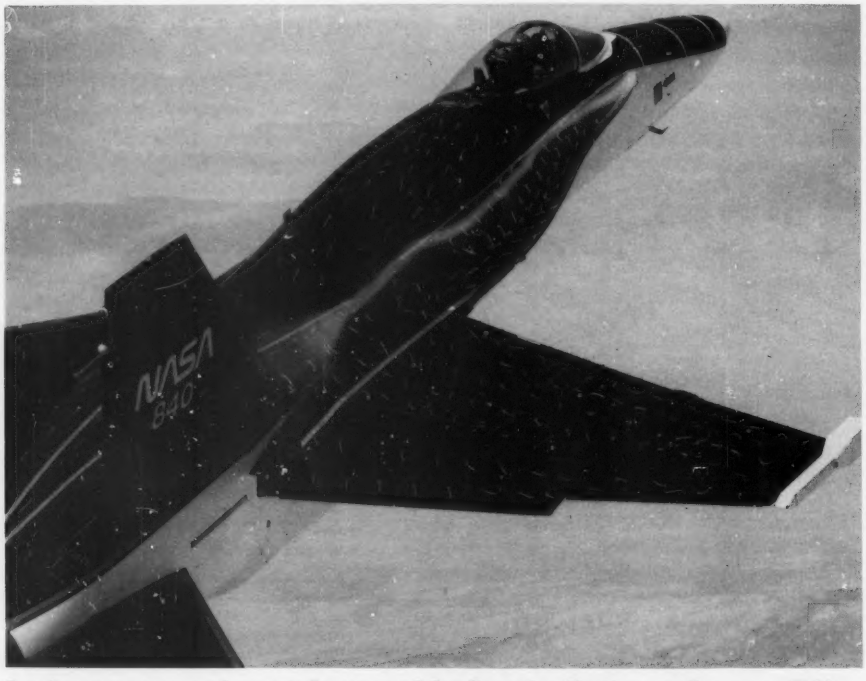
F/A-18 Flies at Dryden

By Don Haley, DFRF

NASA is using initial data from the first phase of a research program studying airflow during high angle-of-attack flight to validate computer codes and wind tunnel results that should significantly improve design capabilities for future aircraft.

The High Angle-of-Attack Research Program at Ames-Dryden Flight Research Facility, Edwards, Calif., uses an F/A-18 Hornet aircraft on loan from the U.S. Navy. NASA expects the effort to provide information that will lead to increases in maneuverability and make high-performance aircraft safer to fly.

"Angle-of-attack" (or "alpha") is an engineering term for the angle of an aircraft's body and wings relative to its actual flight path. During maneuvers, pilots often fly at extreme angles-of-attack with the nose pitched up while the aircraft continues in its original direction. This can lead to conditions in which the airflow around the aircraft becomes separated from normal flow paths, and the wings do not produce sufficient lift for the aircraft to maintain altitude.



Smoke generators and yarn tufts are used for flow visualization studies on an F/A-18 flown by NASA in its High Angle of Attack research program. NASA test pilot Edward T. Schneider maneuvers the high performance jet aircraft to an angle of attack of about 30-degrees in a test over California's Mojave Desert, recently.

Data used to improve computational model.

Currently, the extreme complexity of separated airflows encountered on fighter aircraft at high angles-of-attack cannot be modeled adequately during the design process. As a result, an airplane's high-alpha characteristics remain an estimate until it enters development and flight operations. Information from the F/A-18 program will give engineers a better understanding of airflow phenomena over an aircraft's fuselage, wings and tail surfaces at various flight angles and will help engineers to improve control effectiveness on future high-performance aircraft.

"The data we have obtained in the first phase of the program is being used to improve the computational models," said Don Gatlin, Ames-Dryden's F/A-18 High Angle-of-Attack Program Manager. "And from what we've seen, they compare well with wind tunnel data obtained at Langley Research Center and Ames Research Center."

The first phase of the NASA study involved more than 100 research flights at up to 55 degrees angle-of-attack. Separate visual studies of the airflow were made with smoke, cloth tufts attached to the F/A-18's exterior surface and

continued on next page

Research Flight Results continued. . .

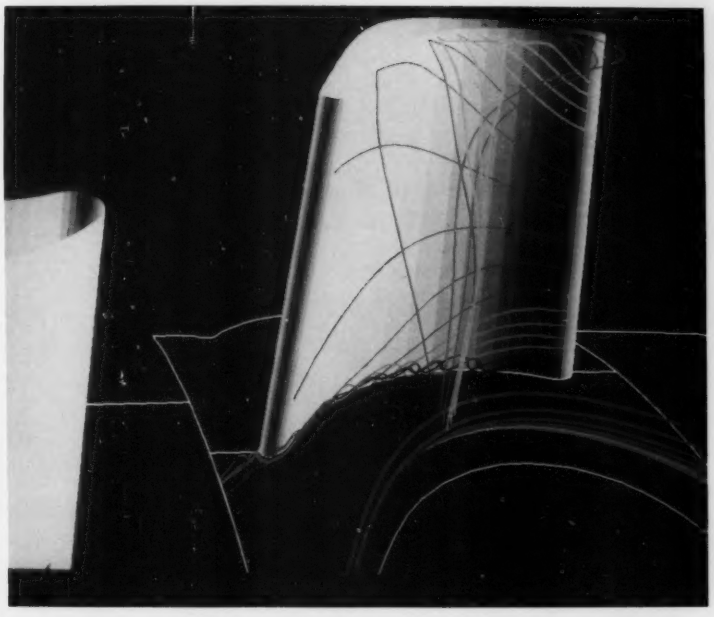
an oil-based dye released from small orifices at the nose of the aircraft. Flow patterns recorded on film, videotape and on the aircraft's surface were compared with computer and wind tunnel predictions. Data also were obtained from an instrumentation system that included pressure sensors installed in a 360-degree pattern around the nose of the aircraft and at many other locations on the aircraft.

Vector exhaust thrust for more control.

The high angle-of-attack study is scheduled to begin Phase Two flights next spring. Three thrust vectoring vanes will be installed around each of the exhaust nozzles of the F/A-18's two jet engines. The movable vanes will change the direction of the engines' exhaust thrust and help to control and stabilize the research aircraft when its rudders, ailerons and elevators become less effective during flights at angles-of-attack up to 70 degrees. Phase Two will continue through the end of summer 1991.

The program is being conducted by NASA's Ames Research Center, Moffett Field, Calif., Langley Research Center, Hampton, Va., and Lewis Research Center, Cleveland. ■

Unusual black over white paint scheme on F/A-18 #840 allows better flow feature photography.



The resolution capability of Lewis' new flow simulation model is depicted in this figure which shows fluid particles moving right to left through the rotor of an axial flow turbine. Particles were released near the rotor hub, as well as near the rotor pressure surface. The paths illustrate the complex flow field and help visualize the migration of low momentum fluid which contributes to performance degradation and shortens the life of the machine.

Improved Computational Simulation of Fluid Flow Developed at Lewis

More Compatible for Designers

NASA Lewis Researchers have developed a new fluid flow simulation model for turbomachinery typical of that in the Space Shuttle main engine and in large-scale jet engines.

Called the "average passage" flow model, it resolves flow features which directly influence the performance of turbomachinery while averaging over those features which are of secondary importance.

As a result, execution simulation times using today's supercomputers become compatible with the engineering design environment.

This new model provides greater insight than current models into the flow structures which originate in the hub and tip region of multistage turbomachinery designs. These flow structures are known to significantly affect the performance of turbomachinery for space and air-breathing propulsion.

Researchers anticipate that these features will become more important in advanced large-scale jet engines of the future and advanced Space Shuttle main engines. ■

Langley's Visitor Center

The Focus is on Flight

By Marney Skora, LaRC

With the push of a button, the cockpit of a Boeing 727 fades into the streamlined, computerized "Flight Deck for the Future," at the Langley Visitor Center. The center, which has finalized modifications to its Aeronautics Gallery, features 24 aeronautics exhibits showing the aerotechnology of the future.

The "Flight Deck For the Future" exhibit simulates a complex computer flight system which will be used by commercial airlines in the next fifteen years. It is a full-scale model of the Advanced Concept Flight Station Simulator, the forerunner of future flight decks, now being tested by NASA.

With this future flight deck, color video screens will continuously display flight data. The pilot will be able to select information by a touch to the screen. Similarly, the Center's new exhibit allows visitors to call up flight information on a video screen: primary flight and navigation, warnings and traffic, engine status and the copilot's electronic checklist.

These fully-automated systems will increase the pilot's awareness of every aspect of flight status. They are designed to reduce pilot workload, increase operating efficiency and improve safety.

The "New Shapes in Tomorrow's Skies" exhibit illustrates the radically different designs now being tested for future aircraft. When visitors step into the dark room of this exhibit, lights give the illusion of stars in space and an infrared switch activates the program. A narrator explains these new designs, some of which may fly by the end of this century.

The National Aero-Space Plane exhibit provides information on a research program that is presently receiving strong technical support from NASA Langley. As envisioned, this plane will take off horizontally from conventional jet airports and fly into space at speeds up to 25 times the speed of sound. Another vehicle which might evolve from this technology is a hypersonic transport capable of flying from the United States to Tokyo in two hours. ■

Ames-Dryden B-52 Crew Prepares for Over Water Pegasus Launch

With the launch of the Pegasus winged space booster in the near future, Ames-Dryden B-52 crew members who required water survival training, recently visited the Tehachapi mountains' Lake Isabella in Southern California for the Air Force Flight Test Center Survival School's water survival course.

Also included in the survival training were photographers, video and motion picture camera operators, who will fly missions over the Western Aeronautical Test Range, a region that encompasses various types of terrain and climatic conditions.

Training included firing flares, jumping from aircraft into water, parachute handling in water and practicing with survival gear.

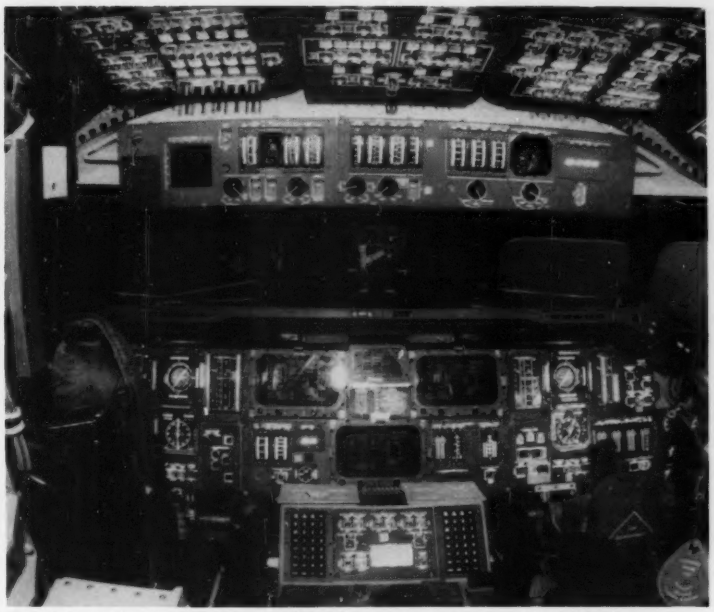
Launch of Pegasus will occur off the California coast, necessitating the water survival training. ■

Q&A

The following questions and answers are excerpted from interviews conducted for NASA's radio program, "The Space Story".

Easy to Fly Airplanes

Every year, thousands of people take flying lessons, with the hope that someday they will pilot their way to the clouds. Unfortunately, many drop out of the flying fraternity because they can't keep up with all the hours needed to learn and practice. Now, NASA engineers are working on systems that will make it easy to train would-be pilots and help keep their skills up to date. Key to their efforts is a re-work of the cockpit instrumentation and control system.



To the student pilot, an airplane's instrument panel can look as confusing as the flight deck of the Space Shuttle Columbia, pictured above.

Q What are the main problems in learning to fly?

A "To my way of thinking, the airplane today...is extremely user hostile and has succumbed to the...'sin of creeping featurism.' ...We've just added more and more features into the cockpit, more instruments, more radios, more knobs to turn, more switches...it's almost a full-time job to learn to fly and stay proficient", says research engineer Eric Stewart of NASA's Langley Research Center in Hampton, Virginia.

Q What effect does this have and what is the answer to this growing complexity?

A Says Stewart, "the pilot has to develop what they call a scan pattern to look back and forth between all of these instruments at one time and then, through some complex mental calculations, go through those calculations to determine the answers to these questions."

Putting a smart computer between the pilot's controls and the controls on the airplane's wings and tail results in an intrument panel that has a simple appearance that harkens back to the planes of another era. Today's flyers still have to determine where they are, where they want to go and what the airplane is doing, but with the new system display called "Highway-in-the-sky", the pilot can respond intuitively to what he must do because the computer makes the calculations and projects the scene onto the windshield...

Says Stewart: "...We chose deliberately to use a road—it's a very simple road with lane stripes on it and a nice horizon out in front of you and telephone poles along the side...something that people are used to seeing. And they are able, without any mental effort, to determine just from looking at the picture, what all the variables are."

Q How does it work with real people?

A Instead of having experienced pilots test the system, Stewart has a novice try it out: "What I've been doing is taking somebody, essentially off the street, somebody who can drive. ...I just explain to them briefly and show them the controls in the cockpit (and) after thirty minutes, I let them fly this simulation from a takeoff, all the way...around the pattern and coming back and landing. Most of them can get around ninety percent of it...But if you contrast that with what it's like now if you give them the basic airplane...They crash within a few seconds!" ■

NASA NEWS CAPSULES

News Capsules are NASA news releases edited by the Internal Communications Branch, Office of Communications.

Truly Presents Lockheed 1988-89 Excellence Award

NASA Administrator Richard H. Truly officially presented NASA's "Award for Quality and Productivity" to Robert Young, President of Lockheed Engineering and Sciences Company (LESC), Houston, in ceremonies held recently at Johnson Space Center, Houston.

Key activities of LESC include support at the Johnson Space Center in Shuttle crew Earth observation activities. Lockheed also has been engaged in critical return-to-flight activities for NASA.

The company was selected from among eight finalists in NASA's fourth annual awards program, which recognizes NASA's aerospace industry contractors, subcontractors and suppliers that consistently demonstrate ways to maintain and improve the quality of their products and services. Lockheed is the first support service organization to attain this honor. ■

U.S./USSR Solar System Working Group Meets in Moscow

The third meeting of the U.S./USSR Joint Working Group (JWG) on Solar System Exploration was held in mid-November, in Moscow. The Soviet delegation was headed by the Director of the Vernadsky Geochemical Institute of the USSR Academy of Sciences, Academician V.L. Barsukov. The U.S. delegation was headed by Samuel W. Keller, NASA Associate Deputy Administrator.

During the meeting, specialists of both sides noted that at the present time the continued exploration of the planet Mars is of primary interest. To increase the scientific return of these and other planetary missions, they agreed to coordinate scientific programs and studies planned in the Soviet Union and the United States. They also agreed on the participation of Soviet and U.S. scientists as co-investigators in each other's projects and on the exchange of scientific data from these missions.

The participants at the meeting held a preliminary discussion of studies required to establish scientific goals for lunar science. ■

Flight Testing Featured in Satellite Video Conference

The nation's leading-edge research aircraft and flight testing was discussed in a recent Educational Affairs Division /Oklahoma State University, Stillwater satellite video conference.

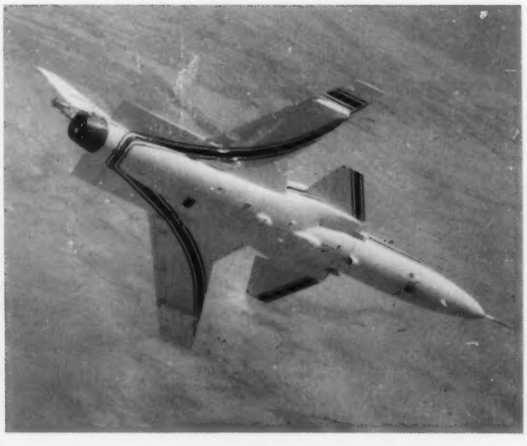
A team of research pilots hosted and discussed aircraft testing from NASA's Dryden Flight Research Facility, Edwards, Calif.

Featured aircraft included the forward-swept-wing X-29 and an F/A-18, used to improve maneuverability and performance. Also featured were the privately-financed Pegasus flight vehicle which is an air-launched space booster deployed from a NASA B-52 aircraft.

These live, 1-1/2 hour, interactive, video conferences are designed to update teachers on NASA programs, demonstrate aerospace activities for the classroom and announce new programs, products and activities available to classroom teachers.

NASA's education satellite, video conference series, now in its fourth year, has been highly praised by educators throughout the nation. This year more than 20,000 educators in 50 states are expected to participate.

Two additional video conferences in the 1989-90 series are: Space Science in the Classroom (SEEDS) - Jan. 23, 1990; and Robotics in Space - Mar. 27, 1990. There is no charge to participate in the video conferences. ■



Forward swept wing X-29 testing at NASA's Ames-Dryden Flight Research Facility was discussed during the educational teleconference.

GLOBE Experiment Measures Aerosol Distribution

A DC-8 aircraft from NASA's Ames Research Center, Mountain View, Calif., has conducted airborne research over the Pacific Ocean to support development of a satellite meteorology instrument scheduled for launch in the late 1990s. The GLOBE (Global Backscatter Experiment) survey flight measured the number and size distribution of atmospheric particles, called aerosols, over remote areas of the tropical Pacific and the northern and southern hemispheres.

The Nov. 6-Dec. 1 expedition of NASA, the National Oceanic and Atmospheric Administration (NOAA) and university investigators collected data between California and Japan, penetrating both polar regions. Fourteen flights surveyed areas believed to contain the lowest average global aerosol counts overall during periods of maximum and minimum dust concentration.

The expedition collected baseline data for the development of the Laser Atmospheric Wind Sounder (LAWS) instrument. When carried on the proposed Earth Observing System (EOS) in polar orbit, LAWS will measure the Doppler shift of aerosol spectra to indicate global wind velocities and directions. As a whole, EOS will provide on-orbit measurements of global climate processes and global water, biological and geochemical cycles.

The measurement of global winds from polar orbit will advance weather forecasting capability, especially over the South Pacific and other regions where ground-based measurements are impossible. Current methods track wind directions and speed through satellite infrared images of clouds, but that data provides limited information about overall atmospheric circulation.

Four experiments aboard the DC-8 involved direct aerosol sampling at the aircraft's altitude of 27,000 feet. The experiments measured amounts of particles 1/100th the diameter of a human hair (1 micron) as well as their optical, physical and chemical properties. Three experiments used lidar to remotely sense particulates at altitudes from 1,000 to 40,000 feet. Lidar is similar to radar but uses visible or infrared light in place of radio waves. The lidar instruments, operating at different wavelengths, measured the energy reflected back (backscatter) by the atmospheric aerosols.

The lead instrument was a pulsed carbon dioxide lidar from the Jet Propulsion Laboratory, Pasadena, Calif., supported by lidars from Goddard Space Flight Center, Greenbelt, Md., and Marshall Space Flight Center (MSFC), Huntsville, Ala. Research aircraft from Japan, Australia and New Zealand provided additional measurements coordinated with the DC-8 flights.

Dr. Ramesh Kakar of the Office of Space Science and Applications, NASA Headquarters, is the GLOBE program manager. Project manager is Dr. James E. Arnold of MSFC. Dean N. Jaynes of the Ames Research Center is mission manager. The GLOBE mission was developed by the Earth Science and Application Division at MSFC. The DC-8 is managed for the NASA Office of Space Science and Applications by the Science and Aircraft Applications Division at Ames. ■

HUMAN FACTORS

McGarvey Honored by GSA for Excellence in Administration

The acting administrator of the General Services Administration recently presented the GSA government-wide, "Excellence in Administration Award" to Billie J. McGarvey at an honors ceremony in Baltimore. He was one of seven recipients from all Federal agencies selected by an independent panel of distinguished Federal administrators.

The award recognizes government managers whose performances demonstrate exemplary service and excellence in administration. McGarvey is the Assistant Associate Administrator for Facilities Management and is the first NASA employee to receive the award which was established in 1986. He was cited for outstanding achievements in agency-wide management of design, development and construction; environmental compliance and restoration; and innovative design/build methods for acquiring operation and support facilities.

Each of the seven honorees received a plaque, a certificate and a significant cash award.

McGarvey was appointed the director of facilities for NASA in October 1978. He came to NASA after serving as assistant deputy chief of staff for Programs and Resources for the U.S. Air Force. A combat pilot in his early Air Force career, then an instructor and engineering test pilot, McGarvey later served in a series of civil engineering assignments of increasing responsibility. He retired from the Air Force as a major general in 1978. He received a Presidential Rank award for senior executives this year. ■

ANOTHER DIVIDEND FROM AIR & SPACE

Common Plants Help Reduce Indoor Air Pollution

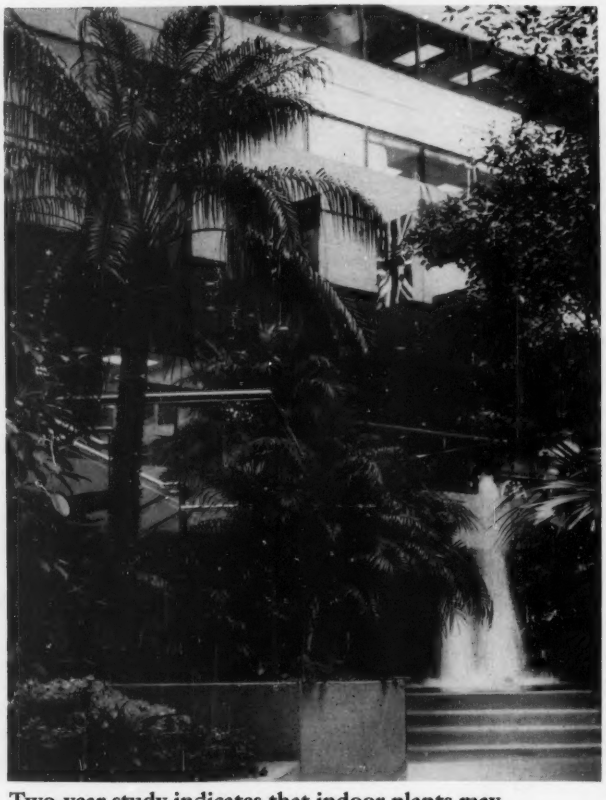
Common indoor plants may provide a valuable weapon in the fight against rising levels of indoor air pollution, based on research conducted by NASA.

A two-year study announced by NASA and the Associated Landscape Contractors of America (ALCA)suggests that the common indoor plant may provide a natural way of combating "sick building" syndrome — an acute incidence of indoor air pollution that can occur in closed or poorly ventilated offices and homes.

Research into the use of biological processes, as a means of solving environmental problems both on Earth and in space habitats, has been carried out for many years by Dr. Bill Wolverton, a senior research scientist at NASA's John C. Stennis Space Center, Bay St. Louis, Miss.

Based on preliminary evaluations of the use of common indoor plants for indoor air purification and revitalization, ALCA joined NASA to fund a study of about a dozen popular varieties or ornamental plants to determine their effectiveness in removing several key pollutants associated with indoor air pollution.

While more research is needed, Wolverton says the study has shown that common landscaping plants can remove keratin pollutants from the indoor environment. "We feel that future results will provide an even stronger argument that common landscaping plants can be a very effective part of a system used to provide pollution-free homes and work places," he concludes.



Two-year study indicates that indoor plants may combat "sick building" syndrome.

Each plant type was placed in sealed, plexiglass chambers in which chemicals were injected. Philodendron, spider plant and the golden pothos were labeled as the most effective in removing formaldehyde. Flowering plants such as the gerbera daisy and chrysanthemums were rated superior in removing benzene from the chamber atmosphere.

Other plants demonstrated to be effective air purifiers include the bamboo palm, peace lily, ficus, mass cane, mother-in-law's tongue, English ivy and Chinese evergreen.

"Plants take substances out of the air through the tiny openings in their leaves," Wolverton said. "But research in our laboratories has determined that plant leaves, roots and soil bacteria are all important in removing trace levels of toxic vapors."

"Combining nature with technology can increase the effectiveness of plants in removing air pollutants," he said. A living air cleaner is created by combining activated carbon and a fan with a potted plant. The roots of the plant grow right into the carbon and slowly degrade the chemicals absorbed there," Wolverton explains. ■